



National Aeronautics and Space Administration

**Goddard Earth Science Data Information and
Services Center (GES DISC)**

README Document for

MODIS Land Cover Type Yearly L3 500m MAIRS Region

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Goddard Earth Sciences Data and Information Services Center (GES DISC)

<http://disc.gsfc.nasa.gov>

NASA Goddard Space Flight Center

Code 610.2

Greenbelt, MD 20771 USA

Prepared By:

Suhung Shen

Name

GES DISC

GSFC Code 610.2

Dec 22 2011

Date

Name

External Organization

Reviewed By:

Gerasimov, Irina V.

Jan 6 2012

Reviewer Name

GES DISC

GSFC Code 610.2

Date

Goddard Space Flight Center
Greenbelt, Maryland

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<i>Revision Date</i>	<i>Changes</i>	<i>Author</i>
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1.0 Introduction

This document provides basic information for processing and using MODIS Terra+Aqua combined Land Cover Type Yearly L3 500m over MAIRS region.

The dataset consists of the land cover types from five classification schemes. The products are generated for regional climate studies associated to the land cover/land use changes over Monsoon Asia regions.

1.1 Dataset Description

The datasets (MCD12Q1_MAIRS_<scheme>.005) in this collection were processed from MODIS standard product: MCD12Q1.005 (Land Cover Type Yearly L3 Global 500m SIN Grid, collection-5) downloaded from USGS and NASA Land Processes Distributed Active Archive Center (LP DAAC). The <scheme> in the dataset name is one of the five classification schemes:

IGBP: International Geosphere Biosphere Programme (IGBP) global vegetation classification scheme

UMD: University of Maryland (UMD) scheme

LAI: MODIS-derived LAI/fPAR scheme

NPP: MODIS-derived Net Primary Production (NPP) scheme

PFT: Plant Functional Type (PFT) scheme

The corresponding five products are:

MCD12Q1_MAIRS_IGBP.005: MODIS/Terra+Aqua Land Cover Type (IGBP) Yearly L3 500m MAIRS Region

MCD12Q1_MAIRS_UMD.005: MODIS/Terra+Aqua Land Cover Type (UMD) Yearly L3 500m MAIRS Region

MCD12Q1_MAIRS_LAI.005: MODIS/Terra+Aqua Land Cover Type (LAI) Yearly L3 500m MAIRS Region

MCD12Q1_MAIRS_NPP.005: MODIS/Terra+Aqua Land Cover Type (NPP) Yearly L3 500m MAIRS Region

1.2 Algorithm Background

The original data (MCD12Q1.005) are stored in 10x10 degree tiled files in the sinusoidal projection. In order to integrate the data into NASA GES DISC's online visualization system, Giovanni, and make the data extraction easier for any given point or section within MAIRS study region, the data files were mosaiced and re-projected onto equidistant cylindrical projection (or Equi-rectangular projection) with nearest point sampling method. The output data file covers the entire Asian Monsoon region (0° – 60°N, 60°E – 150°E). Each output data file contains land cover types of one classification scheme. The separation of the data products by scheme was done in order to reduce the file size and to increase the performance of the online system.

The data sets are processed by using MODIS Re-projection Tool (MRT) release 4.0 from the LP DAAC. First, the MODIS Land Cover Type Yearly L3 Global 500m SIN Grid, collection- (MCD12Q1.005) was downloaded for all tiles over the Asian monsoon region. Then, programs **mrtmosaic** and **resample** were run under batch mode with the following setting:

```
SPATIAL_SUBSET_TYPE = INPUT_LAT_LONG
SPATIAL_SUBSET_UL_CORNER = ( 60.0 60.0 )
SPATIAL_SUBSET_LR_CORNER = ( 0.0 150.0 )
RESAMPLING_TYPE = NN (nearest point)
OUTPUT_PROJECTION_TYPE = ER (equi-rectangular projection)
OUTPUT_PROJECTION_PARAMETERS = ( 6371007.181 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0)
DATUM = NoDatum
```

Land cover types were extracted and output into several files for each classification scheme.

1.3 Data Quality

When generating MCD12Q1_MAIRS_<scheme>.005, the near point method is used for re-sampling. The data quality of each grid point is remained as the input data.

In Giovanni, no quality filtering is performed. Therefore, all valid data points at all quality levels are participated in analysis.

For more information about validation and data quality of the input data, please read MODIS land cover type product user's guide (<http://www-modis.bu.edu/landcover/userguide/c/>).

The Algorithm Technical Background Document (ATBD) of the original products can be found from the MODIS land product algorithm web page:

http://modis.gsfc.nasa.gov/data/atbd/land_atbd.php

1.4 Data Disclaimer

The dataset covers Monsoon Asia region (0° – 60°N, 60°E – 150°E) only, and was derived from MODIS standard product MCD12Q1.005. The data are not copyrighted and are open to all for both commercial and non-commercial uses. If you use the data for a publication (research or otherwise), or for any other purpose, we request you to acknowledge data producer (refer to MODIS Land Cover Type Product User's Guide) and to include the following acknowledgement:

"The data used in this effort were acquired from NASA Goddard Earth Sciences (GES) Data and Information Services Center (DISC)"

We would appreciate receiving a copy of publication reference. Please email to gsfc-help-disc@lists.nasa.gov

2.0 Data Organization

Each data file contains one parameter, which is gridded land cover type data of a classification scheme at 500m resolution for a specific year.

2.1 File Naming Convention

The files are named in accordance to the following convention:

MAIRS_MCD12Q1_LAI_L3_v005_20010101.hdf

MAIRS_<product>_L3_<version>_<YYYYMMDD>.hdf

Where:

<product> = MCD12Q1_<scheme> for data of classification <scheme>

<version> = processing version, the current version is v005

<YYYYMMDD> = year, month, day

Filename Example: MAIRS_MCD12Q1_LAI_L3_v005_20010101.hdf

The date string in a file denotes the beginning date of a year.

2.2 File Format and Structure

Files are in HDF-EOS format, which is an extension of the Hierarchical Data Format Version 4 (HDF-4), developed at the National Center for Supercomputing Applications <http://www.hdfgroup.org/>. These extensions facilitate the creation of Grid, Point and Swath data structures, in the case of MCD12Q1_MAIRS_<scheme>.005, it is of the Grid structure.

2.3 Key Science Data Fields

There is one Science Data Field in each data file

MCD12Q1_MAIRS_IGBP.005 → *Land_Cover_Type_1*

MCD12Q1_MAIRS_UMD.005 → *Land_Cover_Type_2*

MCD12Q1_MAIRS_LAI.005 → *Land_Cover_Type_3*

MCD12Q1_MAIRS_NPP.005 → *Land_Cover_Type_4*

MCD12Q1_MAIRS_PFT.005 → *Land_Cover_Type_5*

Read section 3.3 for details.

3.0 Data Contents

3.1 Dimensions

YDim:MOD12Q1 = 14400 ;

XDim:MOD12Q1 = 21600 ;

3.2 Global Attributes

The Global attributes in the file are those output from MRT software, which reflects information of inputs files for mosaicing and re-projecting. The output data files have the followings global attributes that are not listed in the file:

NORTH BOUNDING COORDINATE =60°N
 SOUTH BOUNDING COORDINATE= 0°
 WEST BOUNDING COORDINATE =60°E
 EAST BOUNDING COORDINATE= 150°E
 First Data Point Location = (60°N, 60°E)

3.3 Products/Parameters

Each MCD12Q1_MAIRS_<scheme>.005 data file contains one science data field (parameter) as listed in the following table:

Sds_Name	Sds_LongName	Product_Name	Unit	Data Type	Fill Value
<i>Land_Cover_Type_1</i>	Yearly land cover type 1 (IGBP)	MCD12Q1_MAIRS_IGBP.005	class	8-bit unsigned integer	255
<i>Land_Cover_Type_2</i>	Yearly land cover type 2 (UMD)	MCD12Q1_MAIRS_UMD.005	class	8-bit unsigned integer	255
<i>Land_Cover_Type_3</i>	Yearly land cover type 3 (LAI/fPAR)	MCD12Q1_MAIRS_LAI.005	class	8-bit unsigned integer	255
<i>Land_Cover_Type_4</i>	Yearly land cover type 4 (NPP)	MCD12Q1_MAIRS_NPP.005	class	8-bit unsigned integer	255
<i>Land_Cover_Type_5</i>	Yearly land cover type 5 (PFT)	MCD12Q1_MAIRS_PFT.005	class	8-bit unsigned integer	255

The following table list classes of land cover types of each scheme:

Class	IGBP	UMD	LAI/fPAR	NPP	PFT
0	Water	Water	Water	Water	Water
1	Evergreen Needleleaf forest	Evergreen Needleleaf forest	Grasses/Cereal crops	Evergreen Needleleaf vegetation	Evergreen Needleleaf trees

2	Evergreen Broadleaf forest	Evergreen Broadleaf forest	Shrubs	Evergreen Broadleaf vegetation	Evergreen Broadleaf trees
3	Deciduous Needleleaf forest	Deciduous Needleleaf forest	Broadleaf crops	Deciduous Needleleaf vegetation	Deciduous Needleleaf trees
4	Deciduous Broadleaf forest	Deciduous Broadleaf forest	Savanna	Deciduous Broadleaf vegetation	Deciduous Broadleaf trees
5	Mixed forest	Mixed forest	Evergreen Broadleaf forest	Annual Broadleaf vegetation	Shrub
6	Closed shrublands	Closed shrublands	Deciduous Broadleaf forest	Annual grass vegetation	Grass
7	Open shrublands	Open shrublands	Evergreen Needleleaf forest	Non-vegetated land	Cereal crops
8	Woody savannas	Woody savannas	Deciduous Needleleaf forest	Urban	Broad-leaf crops
9	Savannas	Savannas	Non-vegetated		Urban and built-up
10	Grasslands	Grasslands	Urban		Snow and ice
11	Permanent wetlands				Barren or sparse vegetation
12	Croplands	Croplands			
13	Urban and built-up	Urban and built-up			
14	Cropland/Natural vegetation mosaic				
15	Snow and ice				
16	Barren or sparsely vegetated	Barren or sparsely vegetated			
254	Unclassified	Unclassified	Unclassified	Unclassified	Unclassified
255	Fill Value	Fill Value	Fill Value	Fill Value	Fill Value

4.0 Options for Reading the Data

4.1 Command Line Utilities

4.1.1 ncdump

The ncdump tool can be used as a simple browser for HDF data files, to display the dimension names and sizes; variable names, types, and shapes; attribute names and values; and optionally, the values of data for all variables or selected variables in a netCDF file. The most common use of ncdump is with the `-h` option, in which only the header information is displayed.

```
ncdump [-c|-h] [-v ...] [[-b|-f] [c|f]] [-l len] [-n name] [-d n[,n]] filename
```

Options/Arguments:

<code>[-c]</code>	Coordinate variable data and header information
<code>[-h]</code>	Header information only, no data
<code>[-v var1[,...]]</code>	Data for variable(s) <var1>,... only data
<code>[-f [c f]]</code>	Full annotations for C or Fortran indices in data
<code>[-l len]</code>	Line length maximum in data section (default 80)
<code>[-n name]</code>	Name for netCDF (default derived from file name)
<code>[-d n[,n]]</code>	Approximate floating-point values with less precision filename File name of input netCDF file

Note: the ncdump tool will only display variables whose ranks are great than 1. In other words, you will not see one dimensional vectors using this tool.

In general, the ncdump program can be found in bin directory of the HDF installation area.

Consult your local computer system administrator for the specifics.

4.1.2 hdp

The hdp utility is a HDF dumper developed by HDF group at NCSA.

Usage: hdp [-H] command [command options] <filelist>

`-H` Display usage information about the specified command.

If no command is specified, `-H` lists all commands.

Commands:

<code>list</code>	lists contents of files in <filelist>
<code>dumpsds</code>	displays data of SDSs in <filelist>
<code>dumpvd</code>	displays data of vdatas in <filelist>.
<code>dumpvg</code>	displays data of vgroups in <filelist>.
<code>dumpri</code>	displays data of RIs in <filelist>.
<code>dumpgr</code>	displays data of RIs in <filelist>.

For more information, please visit the NCSA web site: <http://hdf.ncsa.uiuc.edu/hdp.html>

4.1.3 read_hdf

The read_hdf tool is a command-line utility developed by GES DISC. It allows a user to browse the file structure and display data values if desired.

Command line syntax:

```
read_hdf [-l] | [[-i | -d] [-a <output> | -b <base>.*.bin ]] filename
```

Options/Arguments:

- [-i] -- run in interactive mode (default), or
- [-l] -- list a tree of file objects, or
- [-d] -- dump all HDF object types (no filtering)
- [-a <output>] -- ASCII output file name (default is <filename>.txt)
- [-b <base>] -- base binary output file name (default is <filename>)

creates two files per HDF object:
<base>.*.met for metadata, and <base>.*.bin for binary data
(default output to stdout)
filename -- name of the input HDF file

The source code is written in C language and can be obtained from GES DISC ftp server:

ftp://disc1.gsfc.nasa.gov/software/aura/read_hdf

4.2 HDFView

The HDFView is java based GUI application visual tool for browsing and editing NCSA HDF4 and HDF5 files. Using HDFView, you can:

- (1) view a file hierarchy in a tree structure
- (2) create new file, add or delete groups and datasets
- (3) view and modify the content of a dataset
- (4) add, delete and modify attributes
- (5) replace I/O and GUI components such as table view, image view and metadata view

More information can be found at the official [HDFView](http://www.hdfgroup.org/hdf-java/html/hdfview/) web site

(<http://www.hdfgroup.org/hdf-java/html/hdfview/>). There is an add-on [plug-in](#) for handling HDFEOS data specifically.

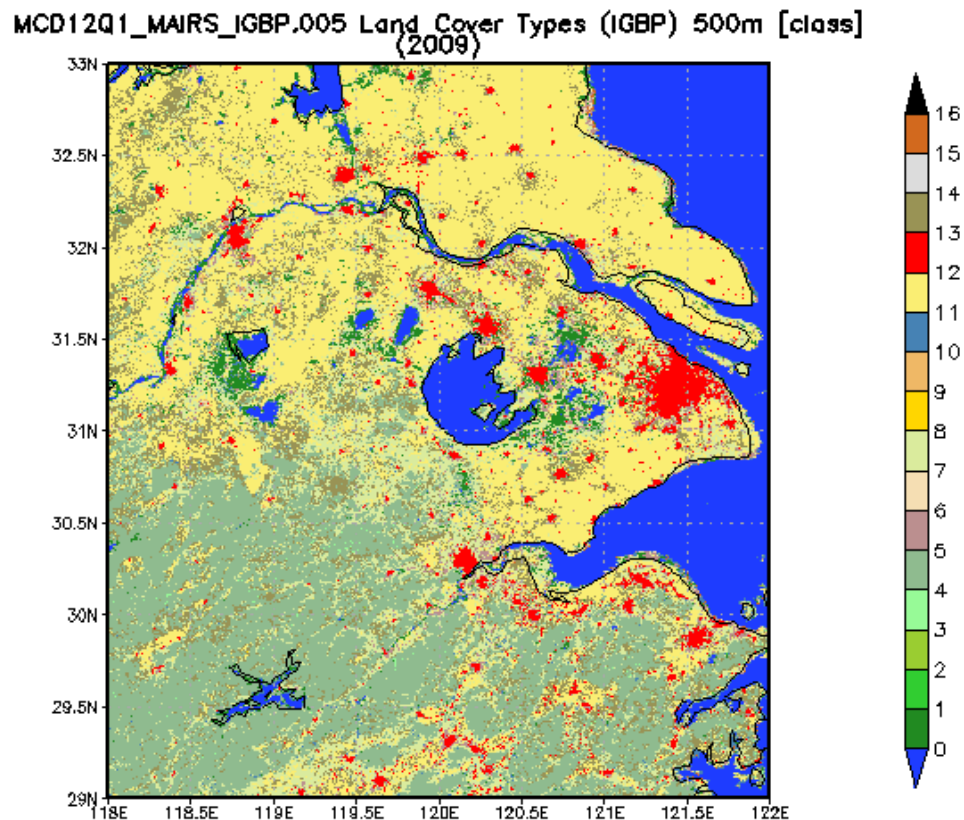
5.0 Data Services

5.1 Access and analysis through Giovanni

Giovanni (GES DISC Interactive Online Visualization AND aNalysis Infrastructure) is Web-based application that provides a simple and intuitive way to visualize, analyze, and access data. The MODIS land cover type data sets MCD12Q1_MAIRS_<scheme>.005 have been integrated into the Giovanni system and are available through the portal named mairs_yearly:

http://gdata1.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=mairs_yearly

The following image is land cover type 1 (IGBP) of 2009 over Yangtze River Delta, China generated by using Giovanni.



5.2 Direct FTP:

The data are available on anonymous FTP site:

ftp://neespi.gsfc.nasa.gov/data/s4pa/Land_Water_Cover/

6.0 More Information

MODIS Land Cover Type Product User's guide:

<http://www-modis.bu.edu/landcover/userguide/c/>

The Algorithm Technical Background Document (ATBD):

http://modis.gsfc.nasa.gov/data/atbd/land_atbd.php

Berrick, S., Leptoukh, G., Farley, J., & Rui, H. (2009). Giovanni: A Web services workflow-based data visualization and analysis system. *IEEE Trans. Geosci. Remote Sens.*, 47(1), 106-113.

Any question regarding data, please contact: gsfc-help-disc@listserv.gsfc.nasa.gov.

7.0 Acknowledgements

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